

Nov. 15, 1966

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3,286,222

PRESTRESSED ELECTRICAL CONTACT

Filed April 9, 1964

FIG. 1.

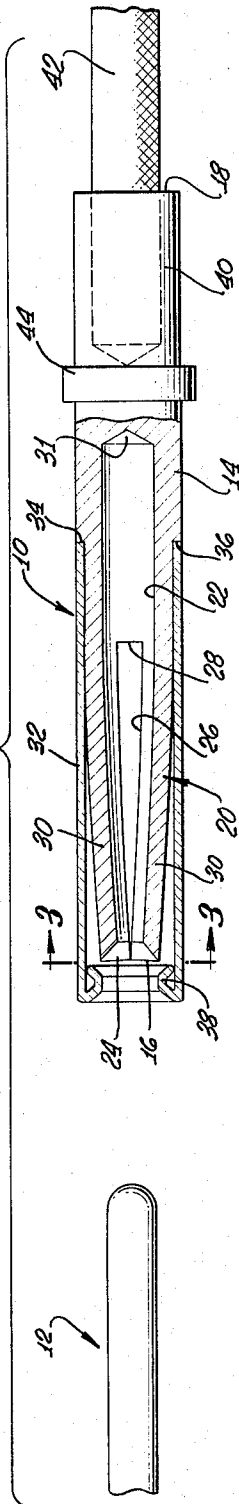


FIG. 2.

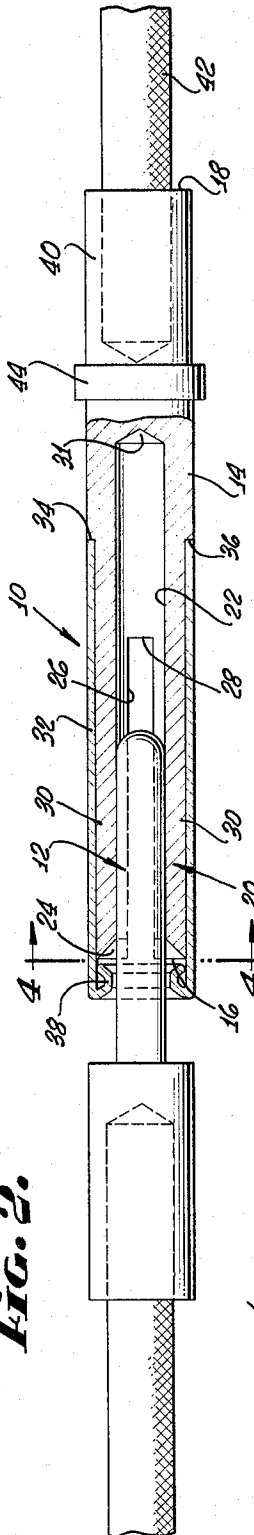


FIG. 3.

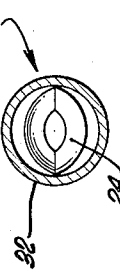


FIG. 4.

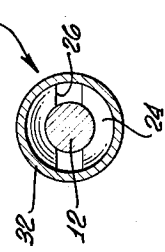


FIG. 5.

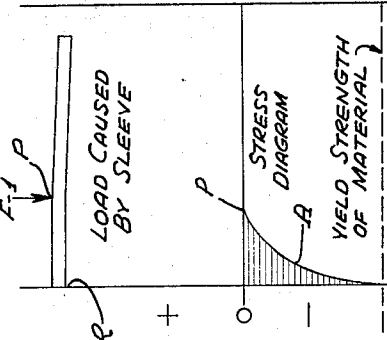


FIG. 5a.

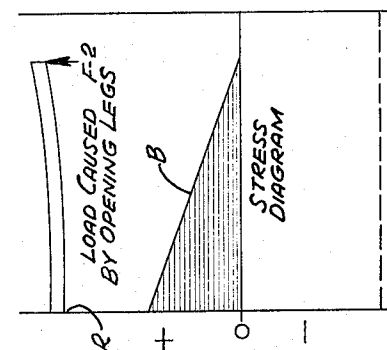
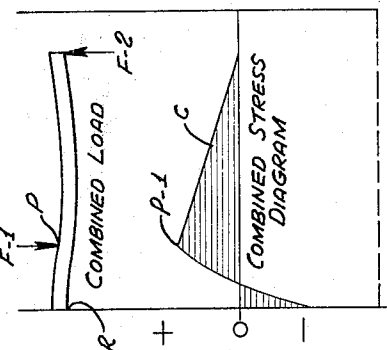


FIG. 5b.



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PRESTRESSED ELECTRICAL CONTACT

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Filed Apr. 9, 1964, Ser. No. 358,497

1 Claim. (Cl. 339-258)

The present invention relates to contact members for electrical connectors, and relates particularly to a contact member having one or more spring contacting fingers which are prestressed in a direction that is opposite to the stress which is applied to them in operation by a mating contact member, whereby the spring characteristics of the spring contact fingers are greatly improved and there is a resultant increase in contacting pressure to provide better electrical and mechanical engagement of the mated contacts.

The mating contact members for electrical connectors usually take the form of a pin contact member and a socket contact member having a tubular engaging portion within which the pin fits. In order to provide good electrical conduction between the mating pin and socket contacts, spring pressure is applied between the pin and socket inside of the socket bore, usually by spring means embodied in the socket contact member. A particularly convenient and simple means for providing this spring biasing means is to utilize a socket tube which is slotted from the forward or engaging end to provide a plurality of spring fingers which are bent radially inwardly so that as the mating pin fits into the socket it will flex the fingers outwardly to provide the spring pressure.

While such tubular socket contact members which are slotted to provide a plurality of spring fingers are widely employed in the electrical connector art, they have an inherent disadvantage in that the cantilever arrangement of the spring fingers projecting free from a tubular base results in the maximum bending stress from outward flexing by a mating pin being applied proximate the roots of the spring fingers. This results in relatively weak spring contacting force between the socket fingers and the mating pin, much less than the actual spring capabilities of the fingers along their lengths.

The fact that the bending stress concentrates and is at a maximum proximate the roots of the socket fingers has the further disadvantage that when the fingers are flexed outwardly by a mating pin contact the elastic limit or yield strength of the material will often be approached, and when a test probe is inserted into a socket contact without proper care there is a likelihood that the elastic limit or yield strength of the material will be exceeded and the fingers will take a permanent set and thereby lose much of their spring capability.

Similar problems occur in connection with other types of contacts for electrical connectors wherein the contacting pressure is developed by laterally flexing one or more spring fingers.

The foregoing problems are accentuated by the fact that copper alloys which it is desirable to use for electrical contact members because of their high electrical conductivity ordinarily have relatively poor spring capability.

Because of these and other problems in the art, it is an object of the present invention to provide an electrical connector contact member of the type having one or more forwardly extending spring fingers which flex laterally upon mating with an opposed contact member, wherein the spring fingers are prestressed in their positions of repose in a direction opposite to the direction of stressing encountered in service, thereby increasing the spring characteristics of the contact material proximate the roots of the spring fingers and hence increasing the spring force exerted by the fingers on the mating contact member, and

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also increasing the amount of flexing which the spring fingers are capable of withstanding in operation or during test probing without exceeding the elastic limit and thereby permanently damaging the fingers.

Another object of this invention is to provide a contact member of the general character described wherein the forwardly projecting spring contacting fingers thereof are prestressed proximate their roots substantially to the elastic limit, whereby the spring characteristics of the contacting fingers are substantially doubled proximate the roots of the fingers, which is the region of greatest bending stress during operation.

A further object of the present invention is to provide a socket contact member of the character described having a tubular engaging portion which is forwardly slotted and pinched together to provide a plurality of forwardly converging spring fingers, with a sleeve circumferentially engaged in hoop compression about the socket tube in the region of the roots of the spring fingers to prestress the spring fingers radially inwardly.

Further objects and advantages of the present invention will appear during the course of the following part of the specification, wherein the details of construction and mode of operation of a preferred embodiment are described with reference to the accompanying drawing, in which:

FIGURE 1 is an axial section, partly in elevation, illustrating a socket contact member according to the present invention, with a mating pin contact member positioned for insertion into the socket.

FIGURE 2 is a view similar to FIGURE 1, but with the mating pin contact member inserted in the socket contact member.

FIGURE 3 is a cross-sectional view taken on the line 3-3 in FIGURE 1.

FIGURE 4 is a cross-sectional view taken on the line 4-4 in FIGURE 2.

FIGURE 5 is a schematic diagram illustrating the direction of the load and the stress applied to one of the socket contact fingers by the prestressing sleeve; FIGURE 5a is similar to FIGURE 5 but illustrates the direction of the load and the stress applied to the finger by a mated pin contact member; and FIGURE 5b is similar to FIGURES 5 and 5a illustrating the combined stress from the prestressing sleeve and the pin contact member.

Referring to the drawing, and at first particularly to FIGURE 1 thereof, a socket contact member 10 according to the present invention is shown in axially aligned, spaced relationship with a mating pin contact member 12 which is adapted to be forcibly inserted into the forward end of the socket to complete an electrical circuit.

The socket contact 10 includes an elongated body 14 having front and rear ends 16 and 18, respectively. The forward engaging or contacting portion of the socket contact member 10 is of tubular construction, having a forwardly opening bore 22 with a beveled entrance ramp 24. The tubular engaging portion is slotted longitudinally down the middle by a slot 26 which extends from front end 16 to rearward end 28 of the slot so as to divide the engaging portion of the socket contact into a pair of diametrically opposed spring fingers or legs 30. These are pinched together to reduce the diameter of the entrance to the tube, so that when the pin contact member 12 is inserted it will flex the fingers 30 outwardly and the fingers will exert a spring contacting force against the pin. The rear end 28 of the slot is disposed forwardly of the rear end 31 of bore 22.

Although the form of the present invention shown in the drawing is slotted to provide two of the spring contacting fingers 30, it is to be understood that any number of the spring contacting fingers may be provided within the scope of the invention.

The socket body 14 is composed of a suitable conducting material having spring characteristics, as for example some alloys of copper. Most such materials which have the desired electrical conductivity have relatively poor spring capabilities, and this is one reason why it is important to have the increased spring characteristics provided by the present invention.

Circumferentially engaged about the tubular forward portion 20 is a sleeve 32. The rear end 34 of sleeve 32 is disposed to the rear of the rear end 28 of the slot, and is positioned against a forwardly facing shoulder 36 on the body. The sleeve 32 extends forwardly beyond the front end 16 of the contact body and has an in-turned forward lip 38 that provides a rigid guide for the mating pin 12.

The rearward portion of the sleeve 32 is tightly engaged over the annular portion of the socket tube immediately to the rear of the slot and against the contacting fingers proximate their roots, i.e. immediately adjacent to and extending somewhat forwardly of the rear end of the slot. The circumscribed part of the socket tube is placed in hoop compression and the root portions of the spring contacting fingers are radially inwardly stressed substantially to the point of elastic limit.

The forward portion of sleeve 32 is not essential for the improved spring characteristics achieved by the present invention, but is useful to provide a fixed outer limit of expansion for the spring fingers and to provide a guide which directs the mating pin contact member into the reduced opening at the ends of the socket fingers.

The contact body 14 has a tubular rearward terminating portion 40 adapted to receive a bared end of a wire conductor 42 which may be soldered or crimped therein. The terminating portion of the socket contact is not a part of the present invention, and any suitable termination means may be employed. A mounting collar 44 is formed on the contact body 14 and likewise does not form a part of the present invention.

FIGURES 1 and 3 show the socket contact with the spring contacting fingers 30 in their positions of repose. FIGURES 2 and 4 show the socket with the pin contact 12 operatively engaged therein, the contacting fingers 30 being spread outwardly and resiliently engaged against the pin to complete an electrical circuit.

FIGURES 5, 5a and 5b schematically illustrate the directions of the forces or loads on one of the spring fingers 30 caused by the sleeve 32 and by the mating pin contact, and the resulting individual and combined stresses on the spring fingers. Referring at first to FIGURE 5, in the upper portion of this figure one of the spring fingers 30 is shown extending outwardly from its fixed root R, with the radially inwardly directed force or load F-1 shown as a downward force against the finger 30 exerted at a point P spaced somewhat to the right of root R. At the lower portion of FIGURE 5 is a stress diagram wherein curve A shows the stress of force F-1 on the finger 30 as a negative stress, starting at root R at the yield strength of the material in a negative or radially inward direction and rising in a curve to zero at point P.

FIGURE 5a shows the spring finger 30 operated on only by the outward flexing force F-2 representing the force or load when the spring fingers are spread by the pin contact member. The stress diagram in the lower portion of FIGURE 5a shows the stress of F-2 as a straight line B having a maximum positive value at the root R and descending to zero at the free end of the finger where F-2 is applied.

FIGURE 5b illustrates the application of both loads F-1 and F-2 to the spring finger 30, and in the combined stress diagram curve C illustrates that when the pin is engaged in the socket, there is a negative or radially in-

wardly directed stress at root R, the stress rising to a maximum at the point P-1 corresponding to the point on the finger at which the sleeve force F-1 is applied, and then falling off linearly to zero at the free end of the finger. The maximum stress, which is at P-1, is seen to be much lower than the maximum stress shown in FIGURE 5a which would be the stress if the compression sleeve 32 were not present.

The effect of the prestressing by compression sleeve 32 is to greatly increase the spring characteristics of the contact material in the critical region proximate and adjacent to the roots of the spring fingers. With prestressing substantially to the elastic limit the spring characteristics are substantially doubled, which substantially doubles the spring force of the contact fingers against the mating pin contact member. Also, when the spring fingers are flexed outwardly by a mating pin contact or by a test probe, they will not approach their yield strength or elastic limit nearly so closely as they would if it were not for the prestressing by the compression sleeve 32; this aspect is of more importance if the sleeve 32 is not extended forwardly so as to enclose the forward portions of the contacting in the accompanying drawing.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be accorded the full scope of the claim.

What I claim is:

A socket contact for an electrical connector which comprises an elongated contact body having rearward terminating means and having a tubular forward portion, said tubular forward portion having forwardly opening longitudinal slot means therein to provide a plurality of forwardly extending spring contacting fingers having their roots at the rear end of said slot means, the said tubular portion extending rearwardly of said rear end of the slot means, said fingers being adapted to receive a mating pin contact member therebetween, and sleeve means circumferentially engaged in substantial hoop compression partly about said fingers proximate their roots and partly about said tubular portion to the rear of said fingers so as to radially inwardly prestress the fingers and the tubular portion to the rear of said fingers and thereby improve their spring characteristics, said fingers are bent inwardly forward of their roots so as to converge toward their forward ends and are radially inwardly prestressed proximate their roots substantially to their elastic limits, the portion of said sleeve means engaging said tubular portion being completely cylindrical with a single inner diameter smaller than said tubular portion when the tubular portion and the sleeve means are in the unstressed condition, whereby the compression on said tubular portion is caused by the radial interference between the sleeve and the tubular portion and is substantially equally applied throughout the length of the interengaging area.

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